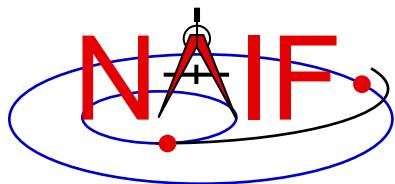


Navigation and Ancillary Information Facility

Toolkit Applications

October 2022



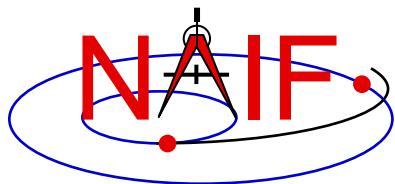
Toolkit Applications

Navigation and Ancillary Information Facility

Toolkit applications create or manipulate kernels, or perform other functions such as time conversion.

Each of the following applications is included in the Toolkits.

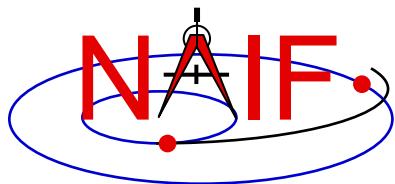
- Time conversion tool: *chronos*
- SPK generation tool: *mkspk*
- SPK merge and subset tool: *spkmerge*
- SPK comparison and sample tool: *spkdiff*
- CK generation tool: *msopck*
- Frame comparison tool: *frmdiff*
- DSK generation tool: *mkdsk*
- DSK export tool: *dskexp*
- Kernel summary tools: *brief*, *ckbrief*, *dskbrief*, *spacit*
- Comments manipulation tools: *commnt*, *spacit*
- File format converters: *tobin*, *toxfr*



Using Toolkit Apps

Navigation and Ancillary Information Facility

- **All of these apps are meant to be used as operating system shell executables**
 - One generally cannot run these within IDL or MATLAB
 - » In some cases you can run from within IDL or MATLAB, but this is not recommended:
 - In IDL, use the “spawn” command
 - In MATLAB, use the “system” command



CHRONOS

Navigation and Ancillary Information Facility

chronos provides a flexible interface to the SPICE Toolkit time conversion capabilities.

chronos supports time conversion between the following time systems/types and using the indicated time types for those systems.

Supported Time Systems --> *Supported Time Types*

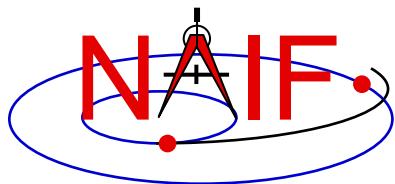
Universal Coord. Time (UTC) --> SCET, ERT, ETT, LT

Ephemeris Time (ET) --> SCET, ERT, ETT, SECONDS, LT

S/C On-board Clock Time (SCLK) --> SCLK, HEX, TICKS

Local Solar Time (LST) --> LST, LSUN

ERT = Earth Received Time
ETT = Earth Transmit Time

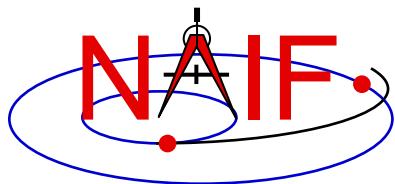


CHRONOS - Input/Output Matrix

Navigation and Ancillary Information Facility

<i>Input System/Type</i>	<i>Output System/Type</i>
UTC / SCET (*)	UTC / SCET (*)
UTC / ERT	UTC / ERT
UTC / ETT	UTC / ETT
ET / SCET (*)	UTC / LT
ET / ERT	ET / SCET (*)
ET / ETT	ET / ERT
ET / SECONDS	ET / ETT
SCLK / SCLK (*)	ET / SECONDS
SCLK / HEX	ET / LT
SCLK / TICKS	SCLK / SCLK (*)
LST / LST	SCLK / HEX
	SCLK / TICKS
	LST / LST (*)
	LST / LSUN

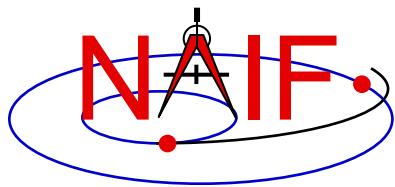
(*) default input/output types



CHRONOS - Miscellaneous

Navigation and Ancillary Information Facility

- ***chronos* normally converts one input time per execution, but can run in batch mode to speed up conversion for multiple input times.**
- **OS shell alias capabilities can be used to define shortcuts for commonly used time conversions.**
- ***chronos* has an extensive user's guide.**



CHRONOS - Usage

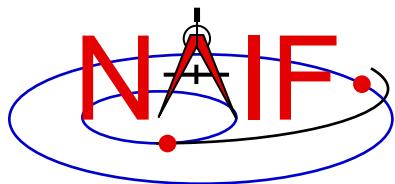
Navigation and Ancillary Information Facility

Terminal Window

```
$ chronos
...
CHRONOS Usage
-----
To convert time from one supported system/type to another:

% CHRONOS -SETUP <setup file name OR kernel file name(s)>
    -FROM <"from" time system>
    [-FROMTYPE <"from" time type>]
    -TO <"to" time system>
    [-TOTYPE <"to" time type>]
    [-FORMAT <output time format picture>]
    -TIME <input time> | -BATCH
    [-SC <sc ID>]
    [-CENTER <central body ID>]
    [-LANDINGTIME <UTC time of the landing>]
    [-SOL1INDEX <index of the first SOL>]
    [-NOLABEL]
    [-TRACE]
```

Items in square brackets are optional



CHRONOS - Example

Navigation and Ancillary Information Facility

Terminal Window

```
$ cat chronos.cas
Sample CHRONOS setup file for Cassini

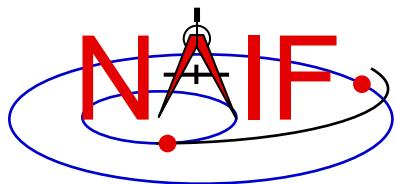
\begindata
    KERNELS_TO_LOAD = ( 'naif0007.tls', 'cas00085.tsc' )
    SPACECRAFT_ID = -82
\begintext

$ chronos -setup chronos.cas -from utc -to et -time 1999 JAN 12 12:00
1999-01-12, 12:01:04.184                                (ET/SCET)

$ chronos -setup chronos.cas -from utc -to sclk -time 1999 JAN 12 12:00
1/1294833883.185                                     (SCLK/SCLK)

$ chronos -setup naif0007.tls cas00085.tsc -sc -82 -from sclk -to utc -time
    1/1294833883.185
1999-01-12 11:59:59.998                                (UTC/SCET)

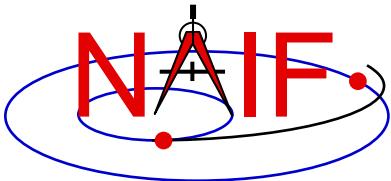
$ chronos -setup naif0007.tls cas00085.tsc -sc -82 -from sclk -to utc -time
    1/1294833883.185 -format 'YYYY-DOYTHR:MN:SC ::RND' -nolabel
1999-012T12:00:00
```



MKSPK

Navigation and Ancillary Information Facility

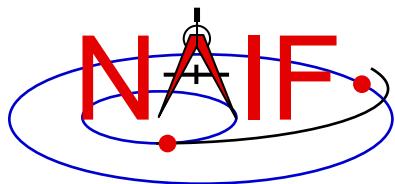
- *mkspk* may be used to generate an SPK file from any of several types of data, such as discrete state vectors, classical orbital elements, and NORAD two-line elements.
- Use of this program is discussed in a separate tutorial about making SPK files, and in the *mkspk* User's Guide.



SPKMERGE

Navigation and Ancillary Information Facility

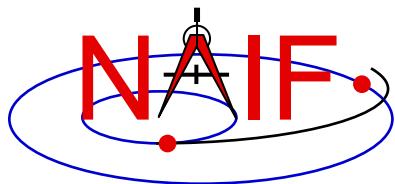
- The contents of an SPK file or set of SPK files may be merged or subsetted using *spkmerge*
 - You can extract an interval of time of interest from a single SPK file or a set of SPK files.
 - You can extract data for one or more objects from a single SPK file or a set of SPK files.
 - You can combine both the time and object selection mechanisms for the greatest flexibility.



SPKMERGE - Precedence Rule

Navigation and Ancillary Information Facility

- SPK files created with *spkmerge* have no overlapping ephemeris data. The order in which the source files are specified determines precedence when source files have overlapping coverage for a body of interest.
 - **IMPORTANT NOTE:** Data from an **earlier** specified source file take precedence over data from a later specified source file when the new (merged) file is created. **This is different from the usual SPICE precedence rules.**



SPKMERGE - Example

Navigation and Ancillary Information Facility

Terminal Window

```
$ cat spkmerge_cas_example.cmd
;This command file directs spkmerge to take data for
;Cassini, the Sun, the Earth, the Moon, and the Earth-
;Moon barycenter and place them into a single SPK.

leapseconds_kernel = naif0007.tls
spk_kernel        = output.bsp
bodies            = -82, 10, 301, 399, 3
source_spk_kernel = de403s.bsp
source_spk_kernel = 990825A_SCEPH_EM52_JP0.bsp

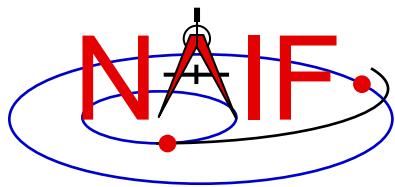
$ spkmerge
SPKMERGE -- SPK Merge Tool, Version 3.2, SPICE Toolkit N0057
```

Enter the name of the command file

```
> spkmerge_cas_example.cmd
```

Creating output.bsp

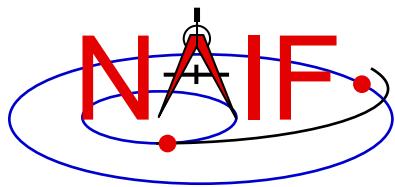
```
$
```



SPKDIFF

Navigation and Ancillary Information Facility

- ***spkdiff* is a command line program for computing the difference between trajectories of two objects obtained from a set of SPK kernels, or for sampling (“dumping”) the trajectory of an object**
- **In comparison mode, *spkdiff* compares trajectories by computing a set of geometric states for a specified body, center and frame over an interval of time with a fixed time step using a set of kernels, then computing another set of geometric states for the same or different body, center, and frame at the same times using the same or another set of kernels, and then subtracting the corresponding states from each other**
 - Depending of the requested output type *spkdiff* prints to the screen:
 - » only the maximum differences,
 - » a complete table of differences, or
 - » a statistical analysis of the differences
- **In sampling mode, *spkdiff* computes a set of states for a specified body relative to another body in a specified reference frame over a specified interval with a specified step**



SPKDIFF - Usage

Navigation and Ancillary Information Facility

Terminal Window

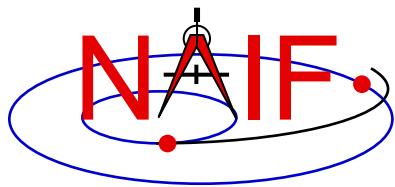
```
% spkdiff
```

... The program usage is:

```
% spkdiff [options] <first SPK name> <second SPK name>
% spkdiff [options] <SPK name>
% spkdiff [options]
```

Options are shown below. ...

```
-k <supporting kernel(s) name(s)>
-b1 <first body name or ID>
-c1 <first center name or ID>
-r1 <first reference frame name>
-k1 <additional supporting kernel(s) for first SPK>
-b2 <second body name or ID>
-c2 <second center name or ID>
-r2 <second reference frame name>
-k2 <additional supporting kernel(s) for second SPK>
-b <interval start time>
-e <interval stop time>
-s <time step in seconds>
-n <number of states: 2 to 1000000 (default: 1000)>
-f <output time format (default: TDB seconds past J2000)>
-d <number of significant digits: 6 to 17 (default: 14)>
-t <report type: basic|stats|dump|dumpvf|dumpc|dumpg (def.: basic|dump)>
```



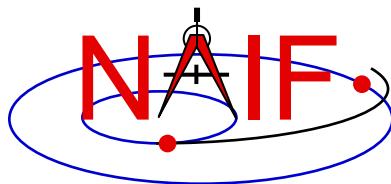
SPKDIFF – Basic Output Example

Navigation and Ancillary Information Facility

Terminal Window

```
$ spkdiff mro_psp.bsp mro_psp_rec.bsp
# Comparison of 1000 'J2000'-referenced geometric states
#
#      of 'MARS RECON ORBITER' (-74) relative to 'MARS BARYCENTER' (4)
#      from SPK 'mro_psp.bsp'
#
# with 1000 'J2000'-referenced geometric states
#
#      of 'MARS RECON ORBITER' (-74) relative to 'MARS BARYCENTER' (4)
#      from SPK 'mro_psp_rec.bsp'
#
# evenly-spaced with 2617.6524668123 second (0d 0h 43m 37.652467s) step size
# within the time interval
#
#      from '2007 APR 01 00:01:05.185 TDB' (228657665.18565 TDB seconds)
#      to   '2007 MAY 01 06:25:00.000 TDB' (231272700.00000 TDB seconds)
#
Relative differences in state vectors:
                                         maximum           average
Position:          8.4872836561757E-05  1.2312974450656E-05
Velocity:         8.5232570159796E-05  1.2314285182022E-05

Absolute differences in state vectors:
                                         maximum           average
Position (km):    3.1341344106404E-01  4.5090516995222E-02
Velocity (km/s):  2.8848827480682E-04  4.2085874877127E-05
```

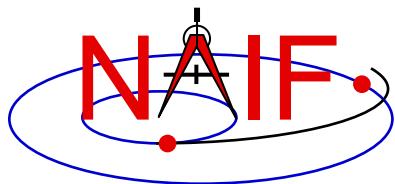


SPKDIFF – Dump Output Example

Navigation and Ancillary Information Facility

Terminal Window

```
$ spkdiff -t dumpvf mro_psp.bsp mro_psp_rec.bsp | more
# Comparison of 1000 'J2000'-referenced geometric states
#
#      of 'MARS RECON ORBITER' (-74) relative to 'MARS BARYCENTER' (4)
#      from SPK 'mro_psp.bsp'
#
# with 1000 'J2000'-referenced geometric states
#
#      of 'MARS RECON ORBITER' (-74) relative to 'MARS BARYCENTER' (4)
#      from SPK 'mro_psp_rec.bsp'
#
# evenly-spaced with 2617.6524668123 second (0d 0h 43m 37.652467s) step size
# within the time interval
#
#      from '2007 APR 01 00:01:05.185 TDB' (228657665.18565 TDB seconds)
#      to   '2007 MAY 01 06:25:00.000 TDB' (231272700.00000 TDB seconds)
#
# time, down_track_p_diff, normal_to_plane_p_diff, in_plane_p_diff, down_track_v
# _diff, normal_to_plane_v_diff, in_plane_v_diff
2.2865766518565E+08 +4.2593079332056E-02 -9.0540866105197E-05 -3.9705894066565E-04 -8.0803561182349E-08
-1.0394439243989E-07 -3.9614350816493E-05
2.2866028283812E+08 +4.2172435702119E-02 +2.3672255851626E-06 -1.1475679619731E-04 +1.3970238250217E-07
+1.4080506259574E-07 -3.9250157214024E-05
2.2866290049059E+08 +4.4830247467488E-02 +9.1590974014175E-05 -7.3802870365833E-04 +5.7800410436763E-07
-1.1724240528272E-07 -4.2099832045985E-05
2.2866551814305E+08 +4.5968515669515E-02 -1.3529652839857E-04 -7.5686845133612E-05 -4.7565892258325E-07
+3.4127364997784E-08 -4.2529268294482E-05
--More--
```



MSOPCK

Navigation and Ancillary Information Facility

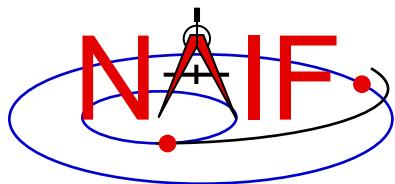
- ***msopck* is a program for making CK files from orientation provided in a text file as a time tagged, space-delimited table**
 - It has a simple command line interface
 - It requires all setups to be provided in a setup file that follows the SPICE text kernel syntax
 - It can process quaternions (SPICE and non-SPICE styles), Euler angles, or matrices, tagged with UTC, SCLK, or ET
 - For more details see the “Making a CK File” Tutorial



FRMDIFF

Navigation and Ancillary Information Facility

- ***frmdiff* is a command line program for sampling the orientation of a reference frame or for computing the difference between orientations of two reference frames based on provided set(s) of SPICE kernels**
- In sampling mode, *frmdiff* computes a set of transformations from one frame to another frame over a specified interval with a specified time step
- In comparison mode, *frmdiff* computes two sets of transformations for two pairs of “from” and “to” frames and then computes the difference in rotation and angular velocity between these transformations over a specified interval with a specified time step
- Depending on the execution mode and the requested output type, *frmdiff* prints to the screen:
 - only the maximum rotation or the maximum rotation difference,
 - a complete table of rotations or differences (as angle and axis, SPICE- or engineering-style quaternions, matrices, or Euler angles), or
 - a statistical analysis of rotations or differences.

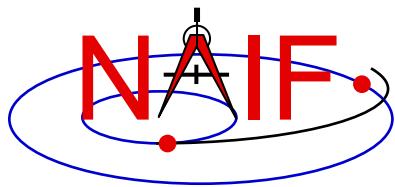


FRMDIFF - Usage

Navigation and Ancillary Information Facility

Terminal Window

```
$ frmdiff
  % frmdiff [options] <first kernel name> <second kernel name>
  % frmdiff [options] <kernel name>
  % frmdiff [options]
where kernel can be a CK, an FK, or a PCK. Options are shown below.
  -k <supporting kernel(s) name(s)>
  -f1 <first ``from'' frame, name or ID>
  -t1 <first ``to'' frame, name or ID>
  -c1 <first frame for coverage look up, name or ID>
  -k1 <additional supporting kernel(s) for first file>
  -f2 <second ``from'' frame, name or ID>
  -t2 <second ``to'' frame, name or ID>
  -c2 <second frame for coverage look up, name or ID>
  -k2 <additional supporting kernel(s) for second file>
  -a <compare angular velocities: yes|no>
  -m <frame for angular velocities: from|to>
  -b <interval start time>
  -e <interval stop time>
  -n <number of points: 1 to 1000000 (default: 1000)>
  -s <time step in seconds>
  -f <time format: et|sclk|sclkd|ticks|picture_for_TIMEOUT>
  -t <report: basic|stats|dumpaa|dumppm|dumpqs|dumpqo|dumpea|dumpc|dumpg>
  -o <rotation axes order (default: z y x)>
  -x <units for output angles> (only for -t dumpaa and -t dumpea)
  -d <number of significant digits: 6 to 17 (default: 14)>
```



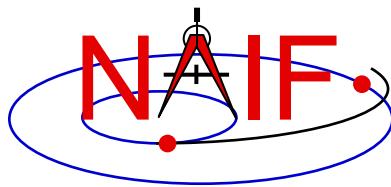
FRMDIFF – Sampling Example

Navigation and Ancillary Information Facility

Terminal Window

```
$ frmdiff -k naif0009.tls DIF_SCLKSCET.00036.tsc di_v17.tf -s 5 -t dumpqo -f sclkd -a yes -m to
dif_sc_2009-01-27.bc > output.txt

$ cat output.txt
#
# Sampling of 16864 rotations
#
#     from 'J2000' (1) to 'DIF_SPACECRAFT' (-140000)
#     computed using
#
#         naif0009.tls DIF_SCLKSCET.00036.tsc di_v17.tf
#         dif_sc_2009-01-27.bc
#
#     with a 5.00000000000000 second (0:00:00:05.000000) step size
#     within the non-continuous (with 2 gaps) time period
#
#         from '2009 JAN 27 00:01:06.713' TDB (286286466.71354 TDB seco...
#         to   '2009 JAN 28 00:01:05.346' TDB (286372865.34683 TDB seco...
#
#     including angular velocities relative to 'to' frame.
#
# Times are decimal SCLKs computed using SCLK ID -140.
#
#     time, q_sin1, q_sin2, q_sin3, q_cos, av_x, av_y, av_z
2.8628543276953E+08 +6.9350853049532E-01 +3.7594179111024E-01 -6.1...
2.8628543776953E+08 +6.9350851552324E-01 +3.7594215798843E-01 -6.1...
```



FRMDIFF – Comparison Example

Navigation and Ancillary Information Facility

Terminal Window

```
$ frmdiff -k naif0009.tls cas00130.tsc cas_v40.tf -s 10 -b 2009-JAN-09 00:00 -e 2009-JAN-10 00:00 -t
dumpaa 09009_09025pa_fsiv_lud2.bc 09006_09011ra.bc > output.txt

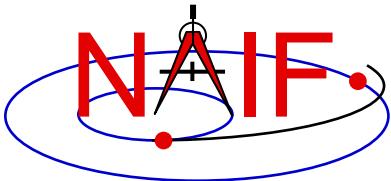
$ cat output.txt
#
# Comparison of 3143 rotations
#   from 'J2000' (1) to 'CASSINI_SC_COORD' (-82000)
#   computed using
#     naif0009.tls cas00130.tsc cas_v40.tf
#     09009_09025pa_fsiv_lud2.bc
#
#
# with 3143 rotations
#   from 'J2000' (1) to 'CASSINI_SC_COORD' (-82000)
#   computed using
#     naif0009.tls cas00130.tsc cas_v40.tf
#     09006_09011ra.bc
#
#
# with a 10.000000000000 second (0:00:00:10.000000) step size
# within the non-continuous (with 1 gaps) time period
#
#
#   from '2009 JAN 09 15:17:06.359' TDB (284786226.35996 TDB sec...
#   to   '2009 JAN 10 00:01:06.184' TDB (284817666.18419 TDB sec...
#
#
# Times are TDB seconds past J2000.
# angle is shown in radians.
#
#
# time, angle, axis_x, axis_y, axis_z
+2.8478622635996E+08 +5.4958832051797E-05 +8.2101753099566E-01 +4....
+2.8478623635996E+08 +5.4931030131424E-05 +8.2046010733260E-01 +4....
```



MKDSK

Navigation and Ancillary Information Facility

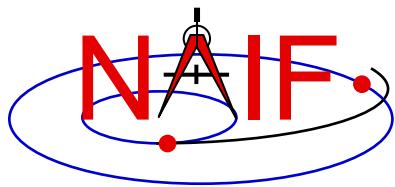
- ***mkdsk* is a program for making Digital Shape Kernel (DSK) files from digital shape data provided in a text file**
 - It has a simple command line interface
 - It requires all setups to be provided in a setup file that follows the SPICE text kernel syntax
 - It can process shape data in one of the following formats:
 - » plate-vertex table
 - » Gaskell shape model
 - » vertex-facet table
 - » Rosetta/OSIRIS “ver” table
 - » ASCII height grid
 - The N0066 MKDSK can output only Type 2 (plate model) DSKs
 - For more details see the MKDSK User’s Guide



DSKEXP

Navigation and Ancillary Information Facility

- ***dskexp* is a program for exporting digital shape data from a DSK file to a text file**
 - It has a simple command line interface
 - The N0066 DSKEXP can export data only from Type 2 (plate model) DSKs
 - It can output shape data in one of the following formats
 - » plate-vertex table
 - » vertex-facet table
 - » Rosetta/OSIRIS “ver” table
 - It creates a separate output file for each DSK segment
 - For more details see DSKEXP User’s Guide

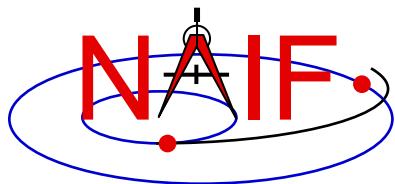


Kernel Summary Applications

Navigation and Ancillary Information Facility

The contents of binary kernels can be summarized using kernel summary tools.

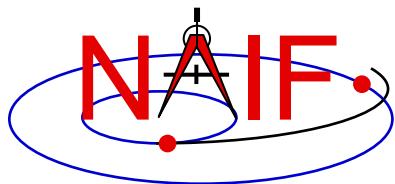
- ***brief*** displays the bodies and associated time coverage in an SPK file or set of SPK files.
 - *brief* also works on binary PCK files
- ***ckbrief*** displays the structure(s) and associated time coverage in a CK file or set of CK files.
- ***dskbrief*** displays a summary of spatial coverage and attributes for a DSK file or set of DSK files.
- ***spacit*** displays a segment by segment summary of the contents of a CK, SPK, binary PCK, or EK/ESQ file.
 - *spacit* also identifies the SPK or CK data type present in each segment.
 - *spacit* does not work on DSK files.



BRIEF

Navigation and Ancillary Information Facility

- ***brief* is a command line program for summarizing the contents of SPK or binary PCK files**
- The files to be summarized can be listed on the command line, given in a meta-kernel provided on the command line, or provided in a list file
- ***brief* provides command line options for**
 - displaying coverage boundaries as date UTC, DOY UTC, or ET seconds past J2000 (default time format is calendar ET)
 - » to display time as UTC an LSK file must be provided on the command line
 - displaying centers of motion along with the bodies
 - treating all input files as if they were a single file
 - displaying a summary only for files covering a specified time or time range or containing data for a specified body
 - displaying a summary in tabular format or grouped by coverage
 - and many others ...



BRIEF - Usage

Navigation and Ancillary Information Facility

Terminal Window

```
$ brief
```

```
...
```

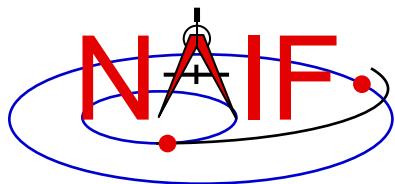
BRIEF is a command-line utility program that displays a summary for one or more binary SPK or binary PCK files. The program usage is:

```
% brief [-options] file [file ...]
```

The most useful options are shown below. For the complete set of options, run BRIEF with the `-h` option. The order of options is not significant. The case of option keys is significant: they must be lowercase as shown below.

- `-c` display centers of motion/relative-to frames
- `-t` display summary in a tabular format
- `-a` treat all files as a single file
- `-utc` display times in UTC calendar date format (needs LSK)
- `-utcdoy` display times in UTC day-of-year format (needs LSK)
- `-etsec` display times as ET seconds past J2000

An LSK file must be provided on the command line to display times in UTC formats. FK file(s) must be provided on the command line to display names of any frames that are not built into the Toolkit.



BRIEF - Example

Navigation and Ancillary Information Facility

```
Terminal Window

$ brief de405s.bsp m01_cruise.bsp

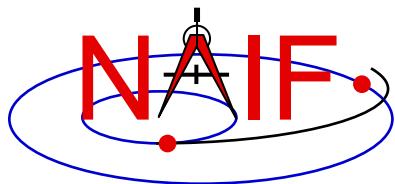
BRIEF -- Version 3.0.0, January 14, 2008 -- Toolkit Version N0063

Summary for: de405s.bsp

Bodies: MERCURY BARYCENTER (1)      SATURN BARYCENTER (6)      MERCURY (199)
        VENUS BARYCENTER (2)        URANUS BARYCENTER (7)      VENUS (299)
        EARTH BARYCENTER (3)       NEPTUNE BARYCENTER (8)     MOON (301)
        MARS BARYCENTER (4)        PLUTO BARYCENTER (9)      EARTH (399)
        JUPITER BARYCENTER (5)     SUN (10)                  MARS (499)
        Start of Interval (ET)           End of Interval (ET)
        -----
        1997 JAN 01 00:01:02.183          2010 JAN 02 00:01:03.183

Summary for: m01_cruise.bsp

Body: MARS SURVEYOR 01 ORBITER (-53)
      Start of Interval (ET)           End of Interval (ET)
      -----
      2001 APR 07 16:25:00.000          2001 OCT 24 05:00:00.000
```

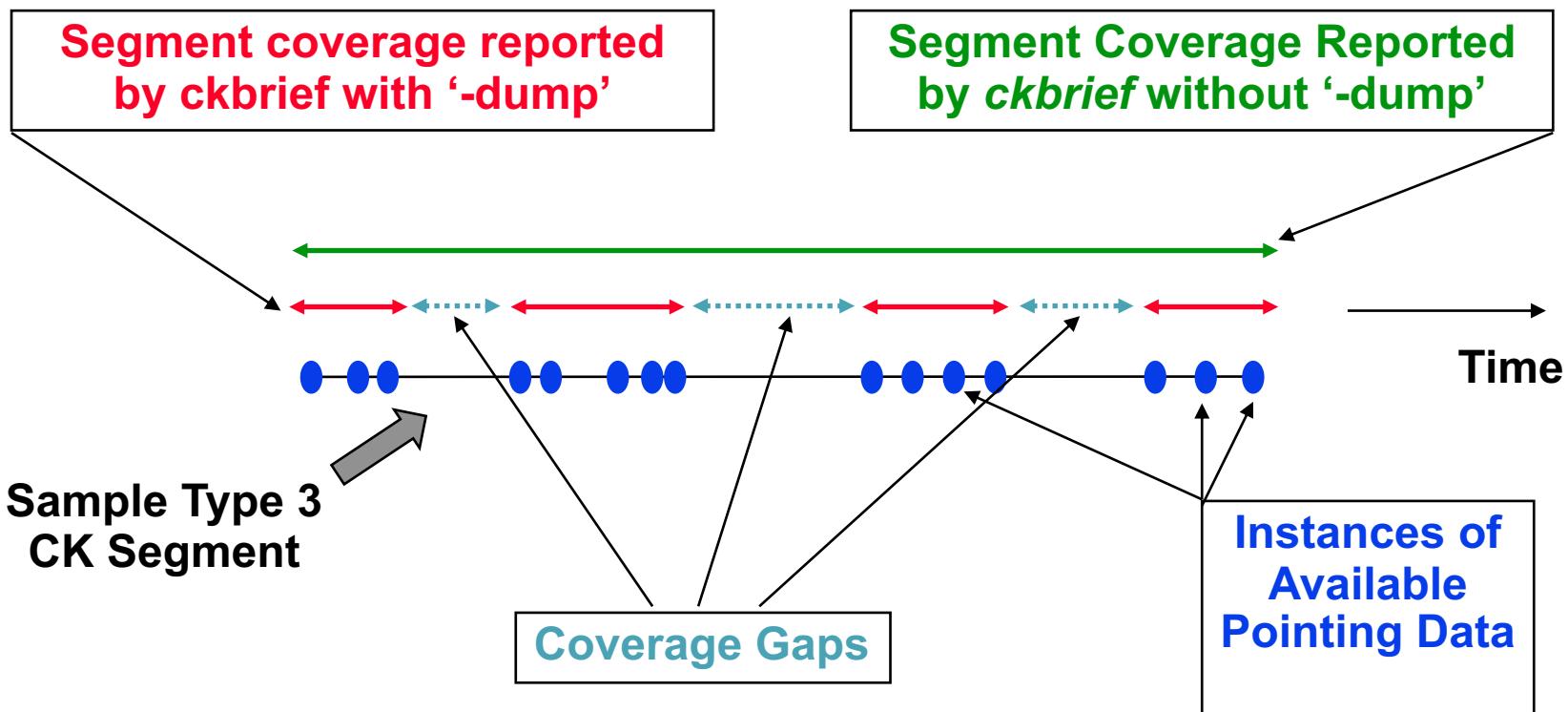


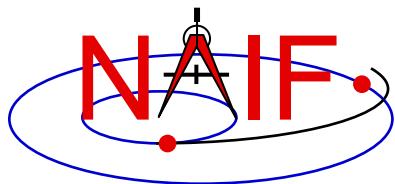
CKBRIEF

Navigation and Ancillary Information Facility

- ***ckbrief* is a command line program for summarizing the contents of CK files**
- The files to be summarized can be listed on the command line, given in a meta-kernel provided on the command line, or provided in a list file
- ***ckbrief* provides command line options for**
 - displaying coverage at interpolation interval level
 - displaying coverage boundaries using UTC, DOY UTC, SCLK, or encoded SCLK (default time format is calendar ET)
 - » To display times as ET, UTC, or SCLK, both an LSK file and a SCLK file(s) must be provided on the command line
 - displaying frames with respect to which orientation is provided
 - displaying the names of the frames associated with CK IDs
 - » An FK file(s) defining these frames must be provided on the command line
 - treating all input CK files as if they were a single file
 - displaying summary only for files with data for a given CK ID
 - and many others ...

- There often are coverage gaps within a CK segment
- Using the ‘-dump’ option allows one to get a complete list of continuous coverage intervals for each segment





CKBRIEF – Usage

Navigation and Ancillary Information Facility

Terminal Window

```
$ ckbrie
```

```
...
```

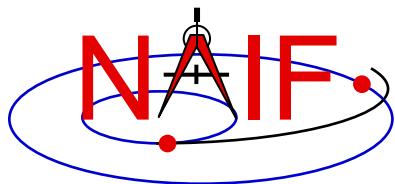
CKBRIEF is a command-line utility program that displays a summary for one or more binary CK files. The program usage is:

```
% ckbrie [-options] file [file ...]
```

The most useful options are shown below. For the complete set of options, run CKBRIEF with the -h option. The order of options is not significant. The option keys must be lowercase as shown below.

-dump	display interpolation intervals
-rel	display relative-to frames (may need FK)
-n	display frames associated with CK IDs (may need FK)
-t	display summary in a tabular format
-a	treat all files as a single file
-utc	display times in UTC calendar date format (needs LSK&SCLK)
-utcdoy	display times in UTC day-of-year format (needs LSK&SCLK)
-sclk	display times as SCLK strings (needs SCLK)

LSK and SCLK files must be provided on the command line to display times in UTC, ET, or SCLK formats. FK file(s) must be provided on the command line to display names of any frames that are not built into the Toolkit.



CKBRIEF – Example

Navigation and Ancillary Information Facility

```
Terminal Window

$ ckbrieft -sclk 981116_981228pa.bc sclk.ker

CKBRIEF -- Version 5.0.0, February 11, 2009 -- Toolkit Version N0063

Summary for: 981116_981228pa.bc

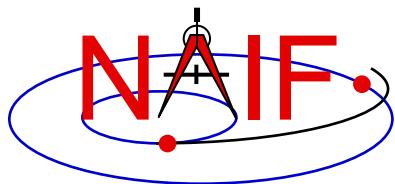
Object: -82000
  Interval Begin SCLK      Interval End SCLK      AV
  -----
  1/1289865849.116        1/1293514473.118      N

$ ckbrieft -utc sclk.ker naif0007.tls 990817_990818ra.bc

CKBRIEF -- Version 5.0.0, February 11, 2009 -- Toolkit Version N0063

Summary for: 990817_990818ra.bc

Object: -82000
  Interval Begin UTC      Interval End UTC      AV
  -----
  1999-AUG-17 17:30:01.418  1999-AUG-17 23:05:42.039 N
  1999-AUG-17 23:05:45.289  1999-AUG-18 06:06:05.874 N
  1999-AUG-18 06:06:09.124  1999-AUG-18 11:52:17.741 N
  1999-AUG-18 11:52:20.991  1999-AUG-18 13:30:00.953 N
```



CKBRIEF - '-dump' Example

Navigation and Ancillary Information Facility

```
Terminal Window

$ ckbrieft mgs_spice_c_kernel_2004-099.bc MGS_SCLKSCET.00053.tsc naif0007.tls -dump
-rel -utc

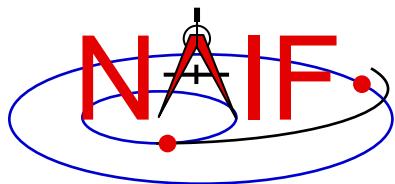
CKBRIEF -- Version 5.0.0, February 11, 2009 -- Toolkit Version N0063

Summary for: mgs_spice_c_kernel_2004-099.bc

Segment No.: 1

Object: -94000

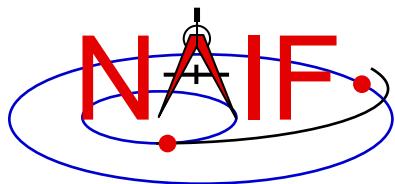
  Interval Begin UTC      Interval End UTC      AV  Relative to FRAME
  -----  -----  -----  -----  -----
  2004-APR-08 00:00:59.809 2004-APR-08 06:53:47.805 Y   J2000
  2004-APR-08 06:54:07.805 2004-APR-08 06:54:07.805 Y   J2000
  2004-APR-08 06:54:19.805 2004-APR-08 06:54:35.805 Y   J2000
  2004-APR-08 06:54:51.805 2004-APR-08 06:54:55.805 Y   J2000
  2004-APR-08 06:55:07.805 2004-APR-08 06:55:07.805 Y   J2000
  2004-APR-08 06:55:23.805 2004-APR-08 06:55:23.805 Y   J2000
  2004-APR-08 06:55:35.805 2004-APR-08 11:59:55.802 Y   J2000
  2004-APR-08 12:00:55.802 2004-APR-08 23:59:55.795 Y   J2000
```



DSKBRIEF

Navigation and Ancillary Information Facility

- ***dskbrief* is a command line program for summarizing the spatial coverage and additional attributes of Digital Shape Kernel (DSK) files**
- **DSK files to be summarized can be listed on the command line or given in a meta-kernel provided on the command line**
 - Additional text kernels containing body, frame, and surface name-ID associations must also be provided to produce complete summary output
- ***dskbrief* provides command line options for**
 - generating extended, full, and segment-by-segment summaries
 - treating all input files as if they were a single file
 - displaying gaps in spatial coverage
 - controlling the number of significant digits in the output
 - and a few others



DSKBRIEF - Usage

Navigation and Ancillary Information Facility

Terminal Window

```
$ dskbrief -u
```

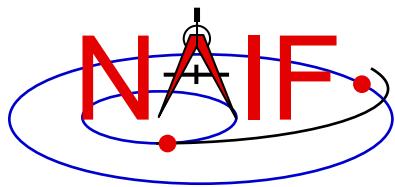
...

DSKBRIEF is a command-line utility program that displays a summary of one or more binary DSK files. The program usage is:

```
% dskbrief [options] file [file...]
```

The available options are shown below. The order of options is not significant. The option keys must be lowercase as shown below.

- a Treat all DSK files as a single file.
- gaps Display coverage gaps. Applies only when -a is used.
- ext Display extended summaries: these include data type, data class, and time bounds. This option applies to summaries of groups of DSK segments.
- tg Require segment time bounds to match when grouping segments.
- seg Display a segment-by-segment summary.
- full Display a detailed summary for each segment, including data-type-specific parameters. This option implies a segment-by-segment summary.
- d <n> Display n significant digits of floating point values.
- v Display the version of this program.
- h Display help text.
- u Display usage text.



DSKBRIEF - Example

Navigation and Ancillary Information Facility

Terminal Window

```
$ dskbrief ROS(CG)_M004_NSPCESA_N_V1.BDS ROS(LU)_M003_OSPCLAM_N_V1.BDS .../FK/ROS_V25.TF
```

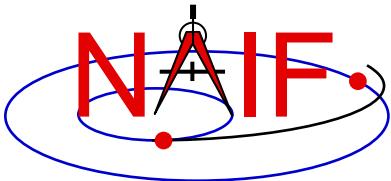
...

Summary for: ROS(CG)_M004_NSPCESA_N_V1.BDS

Body: 1000012 (CHURYUMOV-GERASIMENKO)
Surface: 11000 (ROS(CG)_M004_NSPCESA_N_V1)
Reference frame: 67P/C-G_CK
Coordinate system: Planetocentric Latitudinal
Min, max longitude (deg): 0.00000 360.000
Min, max latitude (deg): -90.0000 90.0000
Min, max radius (km): 4.86351E-01 2.65365

Summary for: ROS(LU)_M003_OSPCLAM_N_V1.BDS

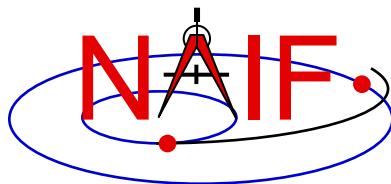
Body: 2000021 (LUTETIA)
Surface: 1011 (ROS(LU)_M003_OSPCLAM_N_V1)
Reference frame name N/A; ID code: -2260021
Coordinate system: Planetocentric Latitudinal
Min, max longitude (deg): 0.00000 360.000
Min, max latitude (deg): -90.0000 90.0000
Min, max radius (km): 33.2395 64.6538



SPACIT

Navigation and Ancillary Information Facility

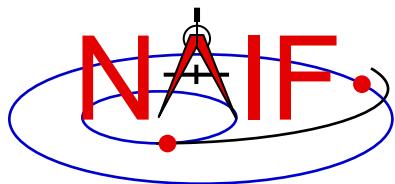
- ***spacit* may be used to obtain a more detailed summary of an SPK or CK file than that offered by *brief* or *ckbrief*, respectively**
 - *spacit* may also be used to summarize a binary PCK or an EK/ESQ.
 - *spacit* is an interactive program
 - » It will prompt you for all needed inputs
- ***spacit* may also be used to manage comments, and to convert between binary and transfer format**



Comment Manipulation Tools

Navigation and Ancillary Information Facility

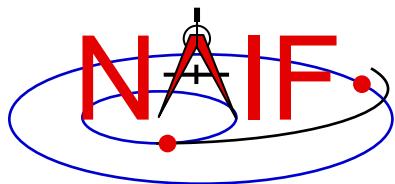
- **Every kernel should contain metadata – called “comments” – describing the file contents, intended usage, etc.**
- **In binary kernels – SPKs, CKs, binary PCKs, DSKs and EKs – comments are stored in a special area of the file called the “comment area.”**
- ***commnt* can read, extract, add, or delete comments stored in the comment area**
 - **Caution:** you cannot add or delete comments if the kernel file is not in native format for the machine on which you’re working.
 - » You can convert a non-native binary format file to native binary format by converting the file to “transfer format” using *toxfr* and then converting it back to binary format using *tobin*.
 - » Or use the *bingo* utility (available only from the NAIF website).



COMMNT

Navigation and Ancillary Information Facility

- ***commnt* is both a command line utility and an interactive menu-driven program**
- **In command line mode, *commnt* provides options to**
 - print comments to the screen
`$ commnt -r kernel_file`
 - extract comments to a text file
`$ commnt -e kernel_file text_file`
 - add comments from a text file
`$ commnt -a kernel_file comment_file`
 - delete comments
`$ commnt -d kernel_file`
- **Important**
 - When comments are added, they are appended at the end of the existing comments
 - Comments should be deleted ONLY if being replaced with better comments



COMMNT - Command Line Example

Navigation and Ancillary Information Facility

Terminal Window

```
$ commnt -r de405.bsp | more
; de405.bsp LOG FILE
;
; Created 1999-10-03/14:31:58.00.
;
; BEGIN NIOSPK COMMANDS

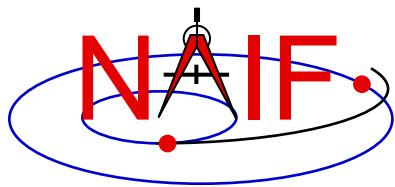
LEAPSECONDS_FILE      = /kernels/gen/lsk/naif0007.tls
SPK_FILE                = de405.bsp
SOURCE_NIO_FILE         = /usr2/nio/gen/de405.nio
BODIES                  = 1 2 3 4 5 6 7 8 9 10 301 399 199 299 499
BEGIN_TIME              = CAL-ET 1950 JAN 01 00:00:41.183
END_TIME                = CAL-ET 2050 JAN 01 00:01:04.183

; END NIOSPK COMMANDS
```

A memo describing the creation of the DE405 generic planet ephemeris is available from NAIF or from the author: Dr. Myles Standish of JPL's Solar System Dynamics Group. Because this memo was produced using the TeX processor and includes numerous equations

>>> Beginning of extract from Standish's DE405 memo <<

...



COMMNT – Interactive Example

Navigation and Ancillary Information Facility

Terminal Window

```
$ commnt

Welcome to COMMNT Version: 6.0.0
(Spice Toolkit N0050)

COMMNT Options

( Q ) Quit.
( A ) Add comments to a binary file.
( R ) Read the comments in a binary file.
( E ) Extract comments from a binary file.
( D ) Delete the comments in a binary file.

Option: E

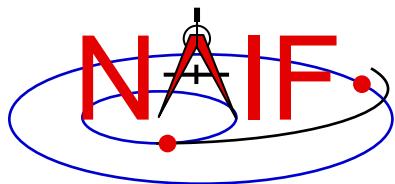
Enter the name of the binary file.

Filename? de405.bsp

Enter the name of the comment file to be created.

Filename? de405_comments.txt

The comments were successfully extracted.
```



File Format Conversion Tools

Navigation and Ancillary Information Facility

- **With modern Toolkits (N0052 and later) the porting of DAF-based binary kernels* between computers having dissimilar binary standards is usually not necessary.**
 - The advent of binary kernel readers that detect the binary style and do run-time translation if needed generally makes porting unnecessary for DAF-based types.
 - Refer to the “Porting Kernels” tutorial for more on this topic.
- **If true porting is needed because you must modify or append to a kernel:**
 - use *toxfr* on the source computer and *tobin* on the destination computer
 - or use *bingo* on the destination computer
 - » **NOTE:** bingo is NOT available in generic Toolkits; it must be downloaded from the NAIF website

* DAF-based binary kernels are SPK, CK and binary PCK